

Appl. No. 10/687,183  
Amdt. dated 10/12/2006  
Response to Office Action of 07/12/2006

Attorney Docket No.: TS03-120  
N1085-90157

### REMARKS/ARGUMENTS

Claims 1-52 were previously pending in this application with claims 1-33 having been previously withdrawn from consideration. Claims 34-52 have been rejected. Claims 34, 39 and 45 are hereby amended, claims 1-33 and 52 cancelled and claims 53-54 added in this paper.

Applicants respectfully believe that each of claims 34-51, 53 and 54 is distinguished from the references of record and respectfully requests allowance of each of claims 34-51, 53 and 54 based upon the remarks set forth below.

#### I. Claim Rejections – 35 U.S.C § 102

On page 2 of the subject Office Action, claims 34-36, 38, 40, 41, 44-46 and 49-50 were rejected under 35 U.S.C. § 102(e) as being anticipated by Sugai (6,569,756). Applicants respectfully submit that these claim rejections are overcome for reasons set forth below.

Independent claim 34 has been amended to explicitly recite that which was inherent in previously pending claim 34, no new matter is being added. Amended independent claim 34 recites the feature that the second copper layer is formed within the same opening as the first copper layer and each have substantially vertical sidewalls that extend along the sidewalls of "the opening" in claim 34. More particularly, claim 34 recites the features of:

a first copper layer having substantially vertical sidewalls;  
and

a second copper layer disposed in said opening and having  
second substantially vertical sidewalls disposed along said  
sides of said opening and directly above and co-linear with  
said first substantially vertical sidewalls.

Sugai does not disclose or suggest this feature of the respective sidewalls being co-linear and the upper sidewall (of the second copper layer) being disposed directly above the lower sidewall (of the first copper layer).

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Sugai, in contrast, referring to FIG. 2C, shows a second copper thin film 6 virtually enveloped by first copper thin film 5 with first copper thin film 5 separating the sidewalls of second copper thin film 6 from the sidewalls of the opening 3. Sugai clearly does not teach the second copper film 6 having substantially vertical sidewalls that are directly above and co-linear with the sidewalls of first copper thin film 5. Claim 34 is therefore distinguished from Sugai. Claims 35, 36, 38, 40, 41 and 44 each depend from independent claim 34 and incorporate the distinguishing features of their base claim 34. Each of claims 34-36, 38, 40, 41, and 44 is therefore distinguished from Sugai and the rejection of these claims under 35 U.S.C. § 102(e) should therefore be withdrawn.

Independent claim 45 has been amended and now recites the feature of:  $G_{D1}$  is greater than to  $G_{D2}$ .

Sugai does not teach this feature. The Examiner contends, in *Response To Arguments*, "the first copper layer is made by CVD process with specific conditions as shown in Col. 5 and the second copper layer is made by sputtering with different conditions, *therefore inherently both copper layers would have different grain densities*", (emphasis added), referring to Sugai. Applicants respectfully disagree with the Examiner's conclusion.

A number of factors including the deposition process used, the deposition process conditions (in particular, the temperature), and the atmosphere and processing conditions during subsequent heat treatments combine to influence the grain density. It is known to one of ordinary skill in the art that grain size and density is strongly related to temperature. Applicants respectfully disagree with the Examiner's apparent position that different film deposition processes cannot yield the same grain density,  $G_{D2}$ , regardless of the combination of processing conditions (including deposition temperature) used and the subsequent heat treatments. The Examiner must take this position in order to conclude, as the Examiner has, that it is inherent that different grain densities must result because Sugai clearly doesn't teach, i.e., disclose, different grain

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densities. In fact, Sugai does not even mention grain densities. Applicants respectfully disagree with the Examiner's position.

5 Sugai, in Columns 4 and 5 teaches forming a first copper thin film using CVD, then reflowing the first copper thin film at an elevated temperature, then depositing a second copper thin film using a sputtering method. The grain density of either thin film is not disclosed and Sugai therefore does not disclose that they are different. Sugai teaches that the first copper thin film is formed using CVD to take advantage of superior step coverage qualities and that the second copper thin film is formed by a sputtering method to take advantage of a significantly increased deposition rate. It is highly  
10 probable that both the first and second copper thin films will have the same grain density if the deposition temperatures are alike. The Examiner has not upheld the burden of providing **evidence** to show that Sugai teaches the first and second copper thin films having different grain densities, as required in taking an inherency position in an anticipation rejection under 35 U.S.C. §102.

15 Since amended independent claim 45 recites the feature that  $G_{D1}$  is greater than  $G_{D2}$ , claim 45 and its dependent claims – claims 47-51 – are distinguished from Sugai and the rejection of claims 45, 46 and 49-50 under 35 U.S.C. §102(e) as being anticipated by Sugai, should be withdrawn.

## **II. Claim Rejections – 35 U.S.C. § 103**

20 On page 4 of the subject Office Action, claims 37-39, 42, 43, 47, 51 and 52 were rejected under 35 U.S.C. §103(a) as being unpatentable over Sugai as applied to claims 34-36, 38, 40, 41, 44-46 and 48-50 and further in view of comments supplied by the Examiner. It is respectfully submitted that these claim rejections are obviated for the reasons set forth below.

25 The comments provided allege that one of ordinary skill in the art would have been lead to the recited copper thickness, width, grain density and the like, as claimed in claims 37-39, 42, 43, 47, 51 and 52, through routine experimentation to achieve a

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desired dimension, device associated characteristics and device density. These comments do not make up for the above-stated deficiencies of Sugai, from which claims 34 and 45 are distinguished for reasons set forth above. Claims 37, 39, 42 and 43 are similarly distinguished by virtue of their dependency from independent claim 34 and  
5 claims 47, 51 and 52 are similarly distinguished from Sugai by virtue of their dependency from independent claim 45. Claim 39 has been amended for clarity and for consistency with the amendment to claim 34. Since the comments that appear in the Office Action do not make up for the above-stated deficiencies of Sugai, independent claims 34 and 45 and therefore also claims 37, 39, 42, 43, 47, 51 and 52 are  
10 distinguished from the reference of Sugai in view of the Examiner's comments.

It is respectfully submitted that the rejection of claims 37-39, 42, 43, 47, 51 and 52 should therefore be withdrawn.

### III. Newly Added Claims 53 and 54

Claims 53 and 54 are newly added dependent claims that depend from  
15 independent claims 34 and 45, respectively. Each of these claims points out a further distinguishing feature of Applicant's invention, mainly, in the embodiment in which no barrier layer is present, the feature that each of the first and second substantially vertical sidewalls are conterminous with the sidewalls of the opening in which they appear. It is respectfully submitted that each of new claims 53 and 54 are distinguished  
20 from the references of record and therefore in allowable form.

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CONCLUSION

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Based on the foregoing, each of pending claims 34-51, 53 and 54 is in allowable form and the application in condition for allowance, which action is respectfully and expeditiously requested.

5 Although no fees are believed due, the Assistant Commissioner for Patents is hereby authorized to charge any fees or credit any excess payment that may be associated with this communication to Deposit Account 04-1679.

10 Respectfully submitted,

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